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REVIEW OF DRAFT FINAL HOT SPOT FEASIBILITY STUDY, NEW BEDFORD HARBOR, MAY 1989, BY EBASCO SERVICES INCORPORATED EPA WORK ASSIGNMENT NO. 04-1L43 EPA CONTRACT NO. 68-01-7250

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The review of this report is divided into two sections: a general summary section and more detailed comments on specific sections of the report. This review is a supplement to an earlier review (July 28, 1989) of a preliminary draft of this report (Ebasco, 1989). The primary focus of this review is on the PCB transport portion of the report, Section 2.3.

SUMMARY

The summary statement for this draft final report remains essentially the same as for the preliminary draft even though substantial revisions have been made in the transport section. The central problem is that the authors try to argue the importance of the hot spot without any supporting evidence to show if it is important to the total release of PCBs to the environment. They incorrectly imply that decreasing the PCB mass in the hot spot leads to corresponding decreases in PCBs released from the sediments. The simplistic assessment performed for the Hot Spot feasibility study (FS) is speculative, undocumented and represents a major step backward from quantitative, realistic feasibility assessments.

SPECIFIC COMMENTS

The section on PCB transport and fate (Section 2.3) has been extensively revised. Some substantial mis-statements or errors noted in the preliminary draft have been

removed or corrected. Substantial problems however remain. These are noted below. In each case a quote from the report is given in italics followed by a response.

p. 2-18

Since the Hot Spot area contains close to half the total mass of PCBs in the estuary, this area will continue to act as a source of PCB contamination to the remainder of the estuary and the lower harbor and bay.

This statement is misleading. It implies, without reference to the literature or to supporting analysis, that reduction of total PCB mass leads to a corresponding reduction in PCBs released into the water column. This basic assumption, which provides the basis for the whole hot spot feasibility study, is erroneous. Isolation and destruction of PCBs that are potentially mobile, (i.e. in the near surface sediments) independent of their total mass, are more important the total mass removed.

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PCB contamination at the lower depth (1 to 4 feet) is limited to areas primarily around the storm water overflows and combined sewer outfall discharge pipes. This contamination at depths greater than 1 foot can be attributed to turbulence and subsequent mixing and deposition of contaminants that occurs around discharge areas.

This argument, while potentially true, is not supported by any analysis or reference to the literature. The hot spot FS report doesn't show the location of the combined sewer or storm water discharge nor does it document the flow rates or pollutant loads discharging to the area.

The contamination at depths greater than 1 foot in the sediment likely has little to do with turbulence and subsequent mixing. In the vicinity of most shallow outfalls is a region of scour caused by the strong currents generated during peak discharge. As the momentum of the discharge dissipates, particulate material carried in the flow or eroded from the bottom deposits on the sea bed. Once on the sea bed, bioturbation and diffusion transport the particle bound pollutant associated with the discharge deeper into the sediments. Resuspension and transport are also possible in high current areas or regions with substantial wave activity.

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Deposition of clean sediment on the surface occurs in the upper estuary, but the process of vertical transport and bioturbation results in the mixing of clean sediment with contaminated material. Examination of sediment core samples from the upper estuary shows no consistent pattern of sedimentation between 5-7.5 cm and 15-17.5 cm depth (Brown and Wagner, 1986). Other reports identified PCB concentrations in the surface layers to be equal to subsurface concentrations, despite the cessation of PCB release, continued sedimentation, and PCB losses to the water column (Brown and Wagner, 1986). Therefore, there is no basis for expecting that natural deposition of clean sediment would effectively cover or dilute the contaminated surface sediment.

The reference to Brown and Wagner (1986) indicating that the upper estuary shows no consistent pattern of sedimentation between 0 - 7.5 cm and 15-17.5 cm depth is incorrect and misrepresents their statement.

What Brown and Wagner (1986) did say was:

> ...there was a general tendency for the A (5 - 7.5cm) and B (15-17.5 cm) (shallow and deep) specimens at each site to be similar in color, texture, and odor; in levels of both oils and PCBs; in the calculated 1242:1254 ratios, extractive losses, and dechlorination indices; in the dechlorination pattern; and also in the patterns of minor, non-PCB peaks on the chromatogram. These similarities occurred despite much wider variations between sites in all of these parameters, and hence suggest that both the oils and the Aroclors had been undergoing vertical diffusion within the sediments at most sites.

There is no mention at all of sedimentation.

Contrary to what is stated there is significant evidence to suggest that the PCB concentrations are low at the surface, increase with depth, reach a maximum, and decrease again as depth increases. As examples:

1. Metcalf & Eddy's (1983) summary of previous sampling data showed that PCB levels there were highest at "shallow" (4-8 cm) depths, and lower at the "surface" (0-4 cm), and in the "deep" (> 8 cm) layers.

2. Balsam's (1989) thin layer PCB sediment analysis from cores collected near the hot spot (site FX) and in the cove adjacent to the CAD (site DR) show maximum PCB sediment concentration at depths of 7-10 cm. For the site near the hot spot (FX) the near surface PCB concentration is a factor of 6 lower than the peak value located at a depth of 10 cm.

3. ASA's (1987) sediment PCB concentration contour maps based on data from USCG (1982), Summerhayes et al. (1977), Battelle (1985), and Huidobro et al. (1983), and interpolated with the assistance of a depositional environments map, generally show that both the surface and deep sediments have lower PCB concentrations than those in the intermediate shallow layer (4-8 cm).

4. Brownawell (1986) sediment PCB concentration data at site 84 (mid Harbor) shows a peak concentration at about 14 cm depth. This peak is approximately 30% larger than the concentration in the 0-4 cm section of the sediment.

The last sentence in the above quote is totally without support either by close inspection of the references given or by the information available for upper New Bedford Harbor.

Berner's (1980) text book on sediment diagenesis, Brownawell's (1986) work in Buzzards Bay and New Bedford Harbor and Thibodeaux's (1989a) calculations using a PCB sediment diffusion model for the upper estuary all suggest that natural sedimentation may be important in covering and diluting contaminated sediment.

The important question concerning the relative roles of sedimentation in isolating PCBs versus bioturbation and the subsequent diffusive release of PCBs at the sediment-water column interface is never discussed.

p. 2-19

It seems unusual that the discussion on volatilization from the water column doesn't include reference to Thibodeaux's (1989b) recent work sponsored by the U.S. Army Corps on the problem.

Thibodeaux (1989a) has shown that the evaporative processes account for approximately 40% of the loss of PCBs from the upper estuary. It seems that this potential route of exposure is much too large to simply ignore.

p. 2-19

The current Hot Spot areas correspond to the locations of the storm water and combined sewer outfall.

There is no evidence presented to show that the Hot Spot areas correspond to locations of storm water or combined sewer outfall discharge.

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Teeter (1988) evaluated particle exchange as one mechanism capable of transporting PCBs from contaminated bed sediment. This process is known to operate in fine, cohesive sediment and suspensions similar to those found in the upper estuary and Hot Spot. Teeter's (1988) analysis proposes that particle exchange could be an important transport mechanism and is considered to be a process of aggregation and disaggregation of cohesive particles resulting from collisions at the interface between suspension and bed sediment layer. PCBs attached to sediment particles at the surface collide with, and can recombine into, aggregates carried by the suspension. The net vertical transport of contaminants with the sediment from particle exchange is in the direction of reduced concentrations. The flux of particle-associated contaminant depends on the mass rate of particle exchange between bed sediment and suspension, and on the differences in contaminant concentration between bed and suspended particles.

The discussion here is interesting but is incomplete in scope and out of context. Teeter (1988) states that the physical particle exchange mechanism is not the only or the most dominant mechanism for escape of PCBs from the sediments. To highlight this mechanism by the above presentation seems to give it undue importance, particularly considering that the dominant mechanism(s) or other mechanisms are not similarly described.

p. 2-20

Another mechanism for mobilizing and transporting PCBs is through sorption and desorption of PCBs onto sediment particles and organic colloidal material (Brownawell, 1986). The interstitial waters from the organic-rich sediment from the upper estuary contain high concentrations of colloidal organic matter (Brownawell, 1986). Brownawell (1986) concluded that interactions between PCBs and organic colloids will influence remobilization of these compounds in sediment and affect their distribution and transport in the water column.

This discussion is interesting and relevant but the authors fail to note that while the three phase equilibrium sorption model proposed by Brownawell (1986) accurately describes the partitioning at stations 67 and M (in Buzzards Bay and the outer harbor) the model does not do well for Station 84 in mid New Bedford Harbor. In fact the data at Station 84 agree more closely with a two-phase, water-suspended particulate partitioning approach. Brownawell (1986) is however unable to explain this difference in model performance between the two sites.

This finding is summarized succinctly in two quotes from Brownawell

abstract, p 3

The sediment-interstitial water results (at sites 67 and M) were contrasted with a study of PCB partitioning in the water column at two stations in New Bedford Harbor. Measured K'_d of PCBs in the water column increased with K_{OW} and approached predictions based on two-phase, water-suspended particulate partitioning when the effect of organic colloids on high K_{OW}-PCBs was considered.

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c) A three-phase equilibrium sorption model in which dissolved PCBs approach a dynamic equilibrium with both sediment and colloidal organic matter can describe the partitioning results at Stations 67 and M, and predicts the near constancy of K'_d with increasing K'_{OW} at all three stations. However, the depth profiles and high values of K'_d at Station 84 are not presently understood.

p. 2-22

The Hoff et al. (1972) reference is not given in the reference list.

p.2-22

The Hot Spot area functions as a substantial source of PCB contamination. The rate of release of PCBs from sediment is so small compared to the amount of material present in the Hot Spot, that release of PCBs will continue.

No analysis is presented to show that the Hot Spot acts as a significant source of PCB contamination. This statement ignores theoretical and experimental work (Thibodeaux, 1989; Berner, 1980) which shows that the flux rate of sediment contaminants declines rapidly with time as the contaminant in the near surface sediments is depleted or as normal sedimentation reduces the concentration near the sediment-water interface. The important issue is the rate of reduction of this flux.

The last sentence again indicates the mistaken notation that all PCBs in the sediment have the same mobility. This is not the case.

p. 2-22

Because site-specific data are not available for the Hot Spot area, it is not possible to determine the relative contribution of each of these transport mechanisms on present or future PCB distribution. Further, it is not possible to confirm that all of these processes are occurring. However, it is known that the Hot Spot represents a discrete area of high PCB contamination. Removing this area will reduce the total mass of PCBs by approximately 48 percent and will decrease the mass of material subject to contaminant migration. Removal and treatment of Hot Spot sediment is the logical first step in the remediation process for New Bedford Harbor.

This summary is a sorry excuse for any real analysis. The Hot Spot feasibility study should provide a quantitative assessment, with associated uncertainties, to estimate the change in PCB flux from the upper estuary sediments to the water column and how remediation of the Hot Spot will affect the total flux.

One critical issue for the upper estuary water quality that has important public health implications is the release of raw sewage through the combined sewer overflows. This issue is totally ignored in assessing the public health risks in the upper estuary.

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